ALION
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Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

28 February 2007

Re: Comments on M2Z Application, WT Docket Nos. 07-16, 07-30

Dear Ms. Dortch,

I am employed by Alion Science and Technology ("Alion"), an employee-owned technology solutions company that delivers technical expertise and operational support to the Department of Defense ("DOD"), civilian government agencies, and commercial customers. Alion has extensive experience in evaluating emerging radio technologies for its customers, which includes prior support to the DOD Joint Spectrum Center and the Defense Spectrum Office of the Defense Information Systems Agency ("DISA"). I have been personally involved in assessing and improving emerging wireless technologies through a number of advisory and standards organizations, including the Federal Communications Commission's ("FCC's" or "Commission's") Technological Advisory Council, the Army Science Board and the Institute of Electrical and Electronics Engineers, Inc. ("IEEE"), as well as other contracted activities focused on enhancing wireless systems performance. One of my more interesting and rewarding recent experiences with Alion has involved the development of a set of metrics and methods to evaluate the spectrum utilization qualities of wireless systems. Called the "Spectrum Scorecard[1]," the process identifies the key technology attributes that either contribute to or detract from effective spectrum utilization. Through the Spectrum Scorecard, we have developed an in-depth understanding about what features comprise a good balance of operational performance and spectrum efficiency.

[1] The Spectrum Scorecard identifies both physical domain attributes (such as power, modulation and frequency control) and logical domain attributes (such as routing protocols and quality of service management), that have a significant combined and interrelated effect on spectrum usage and performance. The Scorecard also suggests metrics and methods for evaluating (scoring) the relative impact of each.

A dominant theme within the defense communications community has been the transformation to network-centric operations—an initiative to provide digital network connectivity from the lowest to the highest echelons of our military forces. In addition, a critical goal of both government and commercial users of wireless technologies continues to be effective spectrum utilization. When we became aware of M2Z Networks, Inc.'s ("M2Z's") Application[2] for a license to provide free nationwide broadband Internet access, it was clear that such a network could provide huge benefits to the civilian community that are analogous to what the network-centric transformation will bring to the DOD, and could deliver such benefits with efficient spectrum use.

Alion has reviewed M2Z's Application and, consistent with the Spectrum Scorecard, has concluded that M2Z's proposed network will use the most spectrally efficient technologies that are currently available for commercial radio systems. Key technological features of M2Z's proposed network include the use of Orthogonal Frequency Division Multiple Access ("OFDMA"), Time Division Duplex ("TDD"), and Adaptive Antennas. These features are also the core technological components of Worldwide Interoperability for Microwave Access ("WiMax"), currently the leading technology for true broadband wireless network access. WiMax deployment has been spurred in recent years by interoperability standards, which ensure that equipment from different vendors can communicate with one another in the same network. As has been the case with Wireless Fidelity ("WiFi") equipment, interoperable WiMax equipment will promote competition and lower prices for consumers.

M2Z plans to use OFDMA technology in its network. OFDMA is spectrum-efficient and flexible, and it can dynamically allocate spectral resources to meet the instantaneous demands of network users. An OFDMA signal splits transmitted information across multiple contiguous narrowband tones (e.g., 256). By allotting variable numbers of tones to each user, it is possible to dynamically adjust each user's information transfer rate while maintaining a constant bandwidth. The dynamic bandwidth allocation feature of OFDMA significantly increases spectral efficiency because each user is only accessing the amount of spectrum he or she

[2] Application for License and Authority to Provide a National Broadband Radio Service in the 2155-2175 MHz Band, M2Z Networks, Inc., WT Docket No. 07-16 (filed May 5, 2006) ("Application").

needs at a particular time.[3] With OFDMA technology, each subscriber's bandwidth allocation and modulation are continuously updated to optimize spectrum performance and utilization.

The M2Z Application also incorporates TDD, an efficient technology that calls for the same spectrum channel to be used for both uplink and downlink communications. By dividing spectrum channels into a continuous stream of short time slots with precise start and end times, TDD makes it possible to assign uplink and downlink transmission intervals to specific time slots. TDD provides flexibility in scheduling access to the frequency spectrum. The channel access can be tailored to the demands of individual users and to their unique needs for uplink and downlink communications in the most spectrally efficient manner. TDD supports a dynamic bandwidth allocation in asymmetric connections, which are common in broadband communications (broadband communications often have uplink rates that vary significantly from downlink rates). Frequency Division Duplex ("FDD") systems, on the other hand, which use separate frequency spectrum for uplink and downlink communications, cannot offer the same level of flexibility as TDD systems. TDD systems can also reduce the potential for self-interference because individual radios do not transmit and receive in the same time slot; this eliminates the added cost and complexity of including a duplexer or interference reduction filters that would be required in an FDD system.

M2Z will optimize the spatial dimension of the radio spectrum by equipping its base station transmitters with adaptive antennas. An adaptive antenna uses signal processors and an array of antenna elements to point antenna beams precisely in the direction of individual network subscribers. Outside of the beam, the signal energy is strongly attenuated and allows the same frequency to be reused several times at a base station. This spectrum re-use provides a tremendous boost in system capacity compared to systems using traditional fixed sectorized or omni-directional antennas. The ability of adaptive antennas to focus RF energy in a particular direction can also improve range, reduce intra-system interference, and enhance coexistence with other in-band and adjacent band

[3] Further, the modulation used on the tones may be adjusted (e.g., 32 QAM, 16 QAM, or 8 PSK) to adapt to each subscriber's link margin. Subscribers with the smallest margin would be serviced by the most robust combination of modulation and forward error corrections. This provides an added level of effective resource usage by providing maximum quality of service to a subscriber within the constraints of available spectrum at any given moment.

systems. I have been a strong advocate for advanced spatial re-use as a "resource multiplier" in emerging wireless systems, and it is gratifying to see proposals implementing this technology.

Alion has reviewed the many favorable responses to the M2Z proposal that have been posted to the FCC's Electronic Comment Filing System and agrees that a nationwide broadband network, as proposed by M2Z, presents a tremendous opportunity for social and economic benefits to the nation. M2Z's proposal also presents an opportunity to advance the state of the art in spectrum utilization and management. M2Z's network includes technology features that simultaneously optimize spectrum use in the frequency domain (i.e., OFDMA), time domain (i.e., TDD), and spatial domain (i.e., adaptive antennas), and is worthy of the Commission's serious consideration. These features, wrapped in a single system, accomplish much of what I and others in this field have been contemplating, visualizing, and promoting for many years.

Sincerely,

Kalle R. Kontson
Vice President and Sector Chief Scientist
E3/SM R&D Operation
Alion Science and Technology